

## 2.4 Evolution by Natural Selection

- ▶ Evolution occurs when natural selection acts on the genetic variability within a populations.
- ▶ Genetic variation arises by chance through genetic mutations and recombination.
- ▶ The process of natural selection, however does not occur by chance.
- ▶ The environment selects individuals that are better suited to their environments.

# DARWIN'S REASONING:

## A - OBSERVATIONS

1. Individuals within a species vary (there is variation in traits)
2. Some variability can be inherited
3. Every generation produces more offspring than can survive
4. Populations tend to stay stable in size

## B - DARWIN'S INFERENCES

1. Members of the same species compete for survival
2. Individuals with more favourable variations are more likely to survive and pass them on (survival not random)
3. As these individuals contribute proportionately more offspring to the next generation, the favourable variations became more favourable – This is Natural Selection

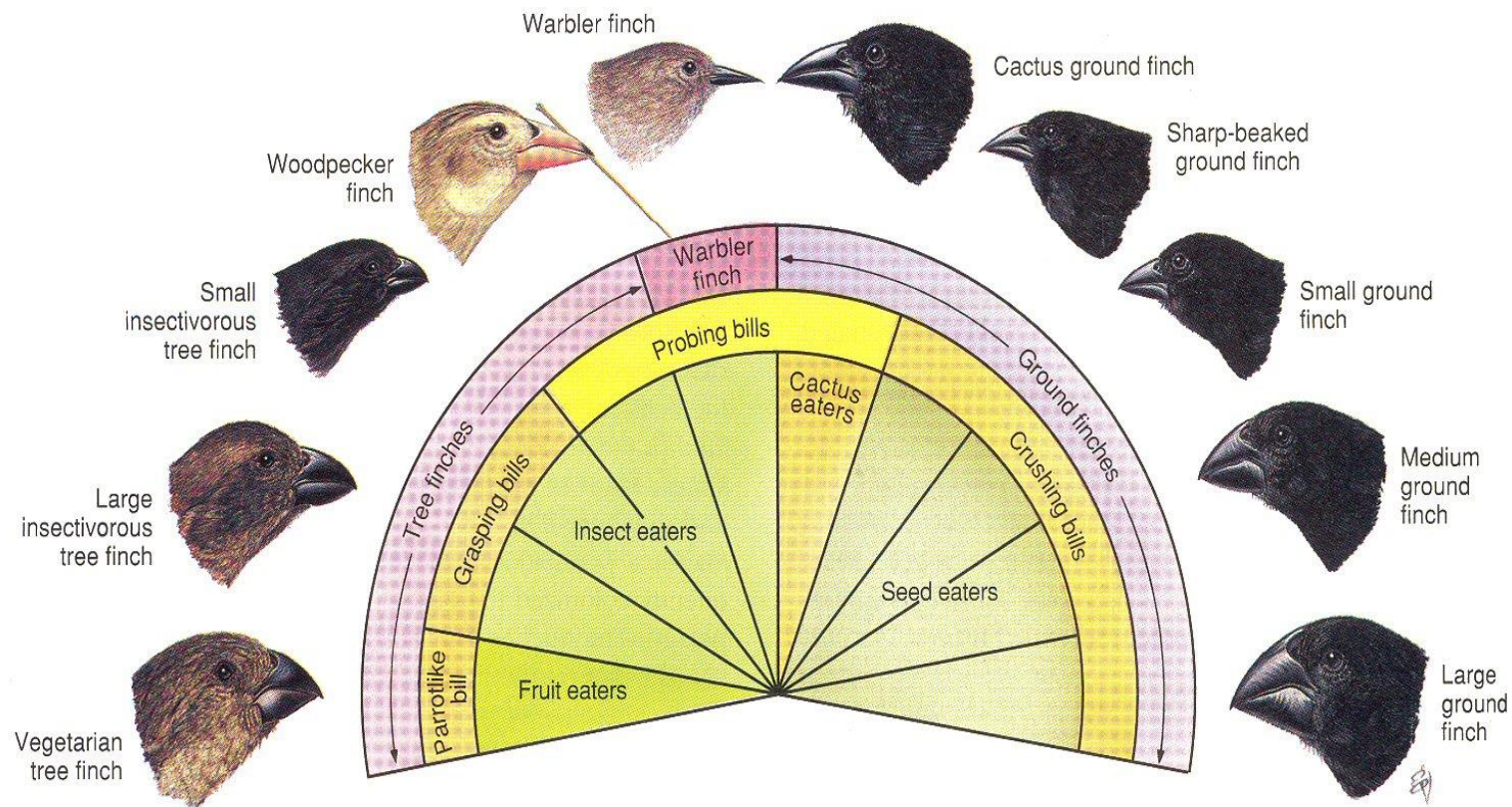
# C - Theory of Natural Selection

- ▶ Over time the population changes as advantageous heritable characteristics become more common generation after generation

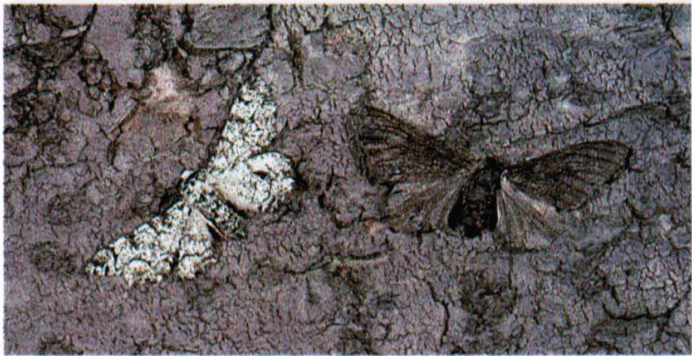
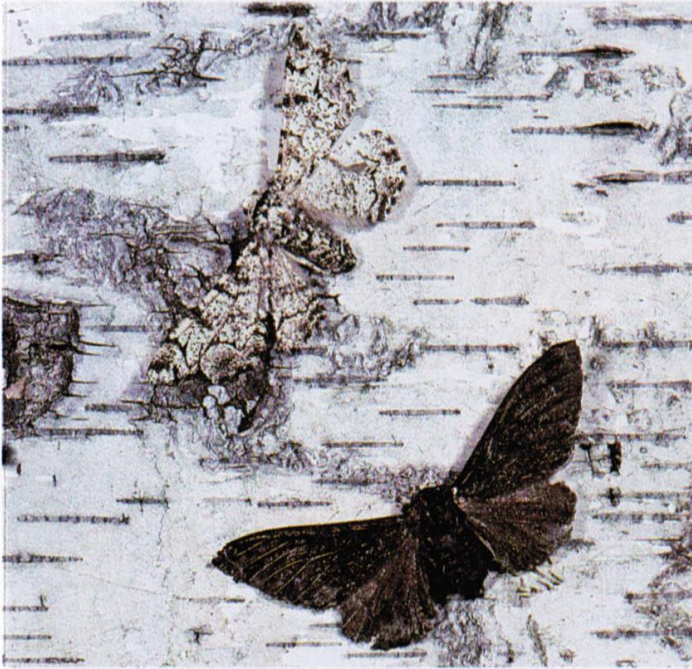
Cool- Natural Selection Game

# Lots of proof

## ► Darwin's finches (beak size vs. drought)







### 33.30 Cryptic coloration of peppered moths

Top: Light and dark morphs of *Biston betularia* at rest on a tree trunk in unpolluted countryside. Bottom: Light and dark morphs on a soot-covered tree trunk. Here the light form is easier to see.

## pepper moth (colour vs. pollution)

- Occurs in two forms
- Grey/white - genotype  $bb$
- Black - genotype  $BB$  or  $Bb$

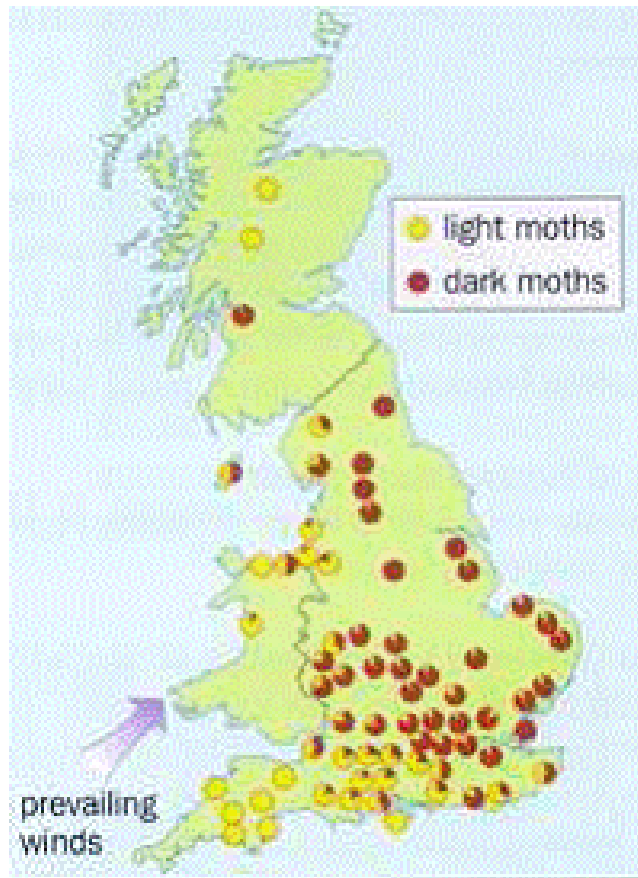
### Grey

- Camouflaged against lichen-covered bark of trees in unpolluted regions

Originally lots of grey and very few black. Why?

With the onset of the Industrial Revolution in England what do you think happened???

Air quality declined, killing off lichen and resulting in marked increase in the frequency of the dark moths.

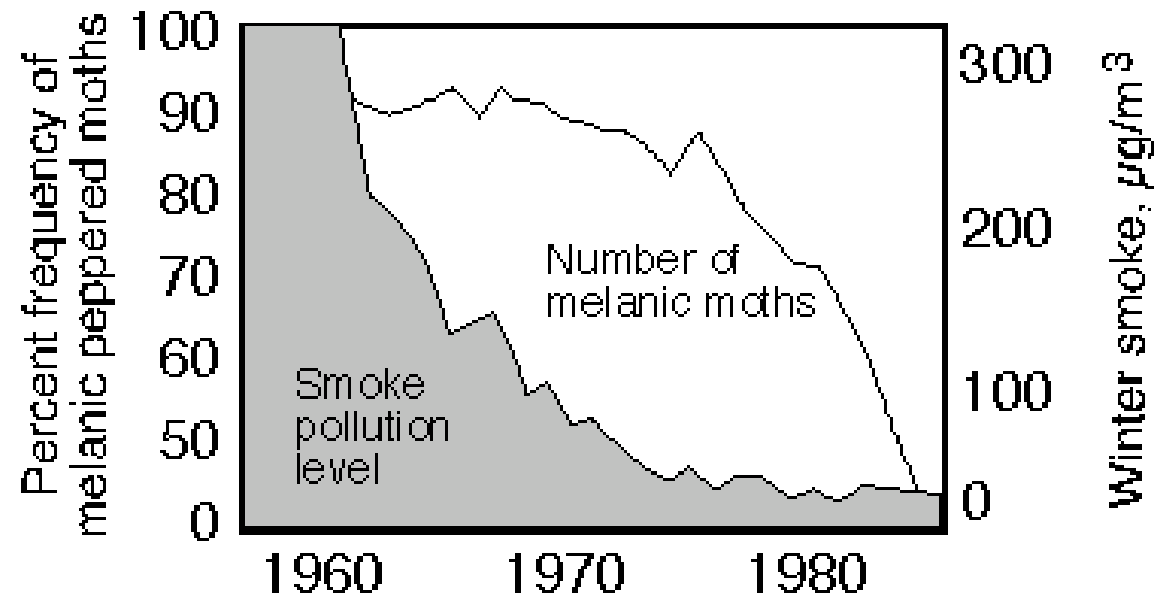


*The proportions of light and dark moths found in Britain today*





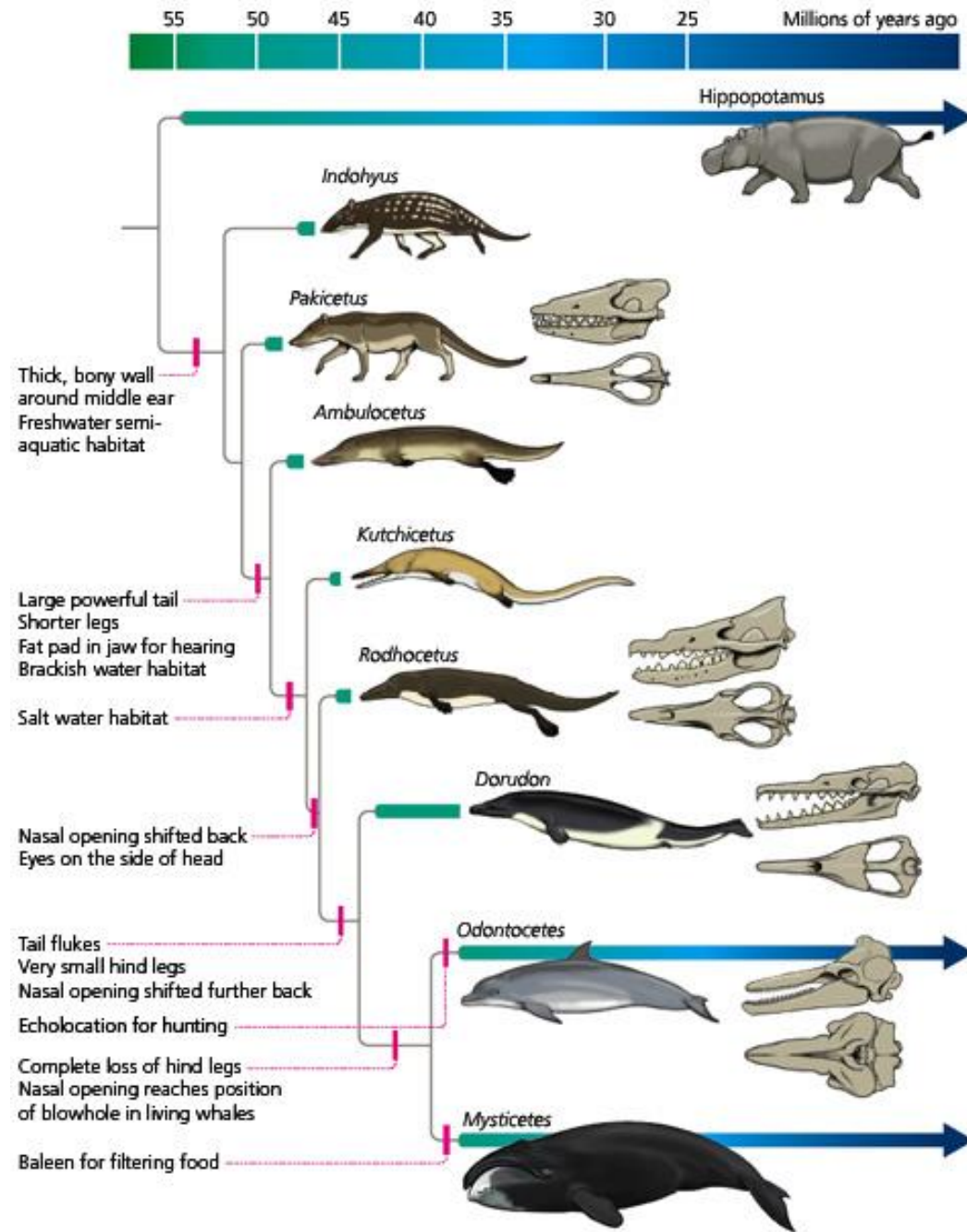
In the 1960's after legislation to control the emissions of coal smoke, the level of pollution in English forests declined.



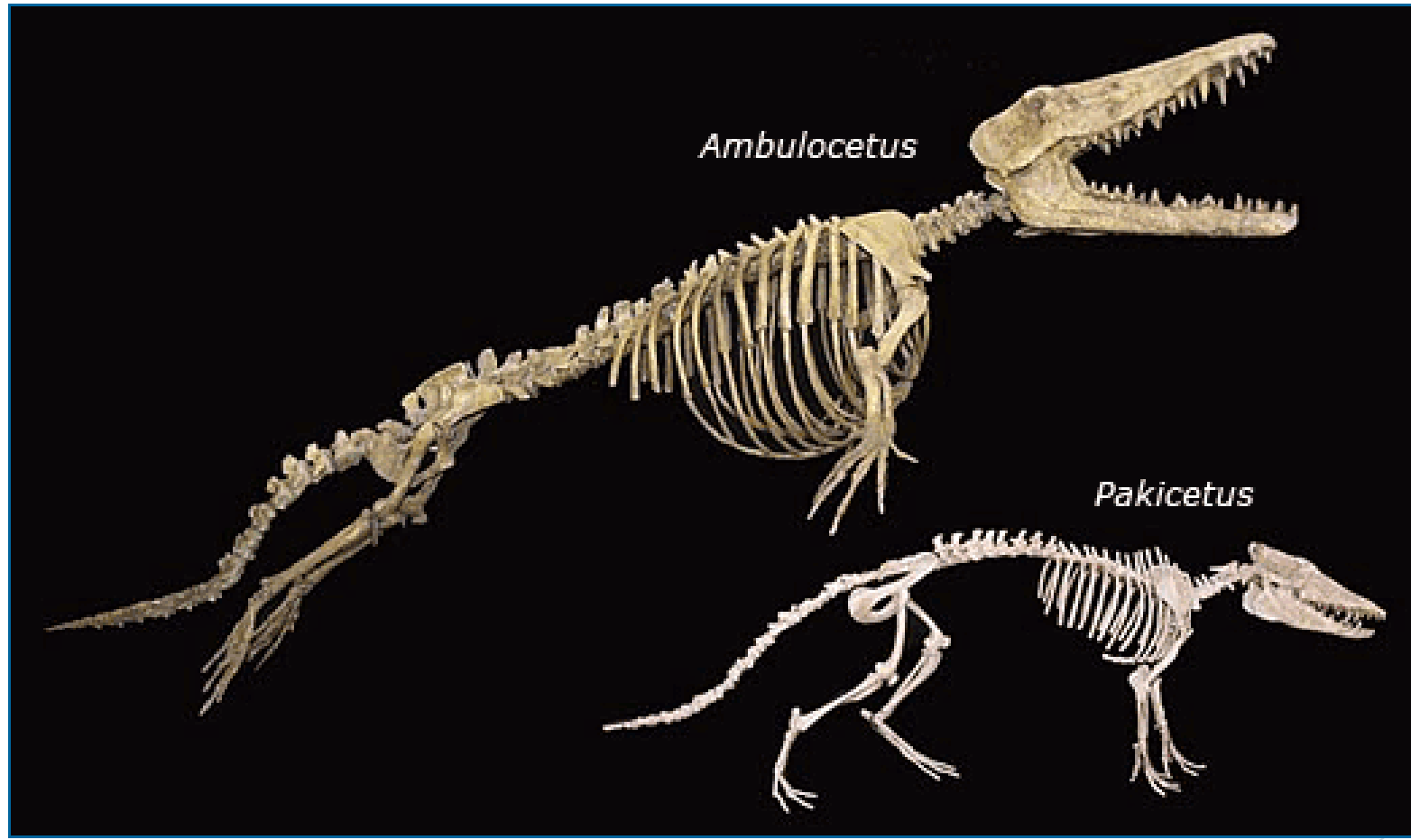
- ▶ \*\*\*\*Darwin's Theory has been debated but accepted\*\*\*\*
- ▶ Thomas Huxley "How extremely stupid to have not thought of it myself"

## Problems/Weaknesses in Theory at Darwin's time

1. some gaps in fossil evidence of transition species
  - fig 3 pg. 531
- ▶ We are filling it in...
  - ▶ whale was found - fully functioning hind limbs (50 m.y.a.)
  - ▶ retained tiny non-functional hind limbs (38 m.y.a)



# Skeletons of two early whales





2. the process would take a very long time – is the world old enough?

▶ Radiometric dating - at least 3.5 billion years old (ample time for N-S.)

3. blending of traits - shouldn't rare variations be diluted rather than being prominent?

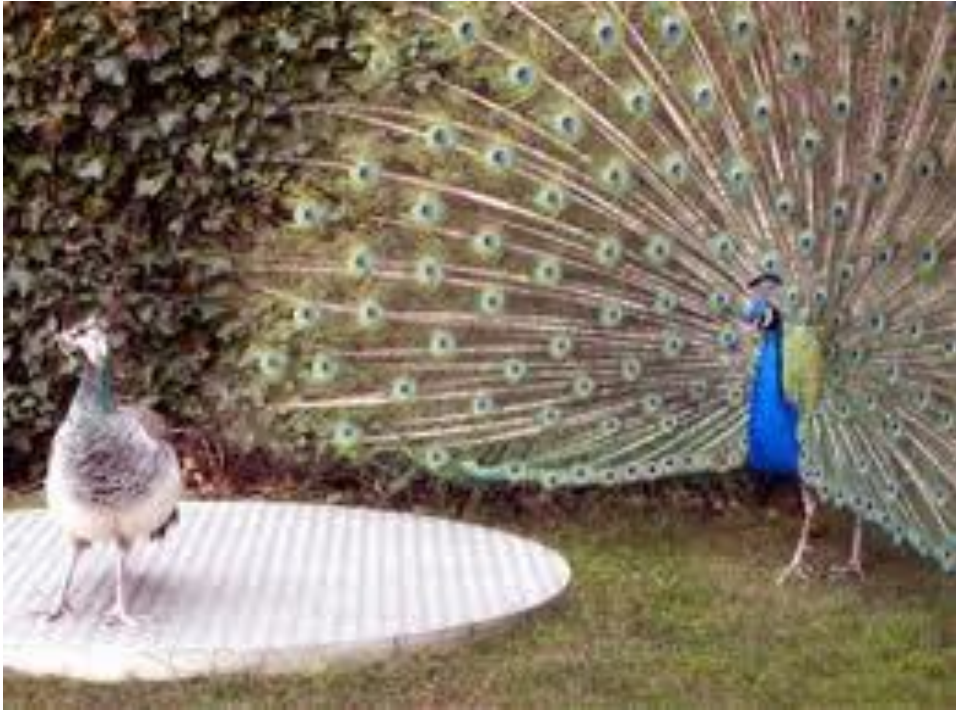
▶ Darwin admitted this was a problem (Mendel helped but much later)

4. Darwin could easily explain the development of long necks in giraffe's but what about the evolution of complex structures (ie. the eye)

- later but same basic process in which each transition step has an advantage.

## Other things to consider:

- ▶ Species change gradually over time due to Natural Selection. Under different selective pressures this can lead to the formation of new species ----- speciation (to come later}
- ▶ Organisms look the way they do since the form is the best adapted form to their particular environment - But what about peacock tails and bright coloured animals. . .  
..is this not imperfection?? Answer???



## Modern Science

- ▶ DNA Fingerprinting and the tools of molecular genetics is proving Natural Selection to be correct. Shows positive proof who is related to whom and their evolutionary paths.
  - ▶ Whales came from a similar ancestor as humans
  - ▶ Chimps share 98.6% of our DNA
  - ▶ A human shares a quarter of our genes with a rice plant

Cool Website



# The Potential for Falsification?

Hypothetical observations with the potential to falsify Darwin's theory	Actual observations and evidence
Amphibians and large land mammals on remote oceanic islands	No native amphibians or large land mammals have been discovered on remote oceanic islands
Fossils of complex organisms found in the oldest fossil deposits	Of millions of fossils, none contradict the predicted pattern of increasing complexity over time
Complex organisms with no vestigial features	All organisms that have been studied in detail exhibit many vestigial features
Species thought to be closely related that share no homologous features with each other	All organisms that have been studied in detail exhibit many features that are homologous with other closely related species